

TERRESTRIAL ECOZONES OF CANADA

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The cover of this report is a reproduction of a National Film Board map of Canada. It is one of the few maps which visually portrays the many environments found across Canada. The map also provides an immediate impression of how many components, such as landforms, vegetation, water bodies, and climate, are associated within a particular environment. The "Terrestrial Ecozones of Canada" map, which was produced independently by the Lands Directorate, is a more technically defined expression of these environmental units. The ecozones, broadly speaking, subdivide the terrestrial environment of Canada based upon the relative homogeneity of ecological characteristics.

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TERRESTRIAL ECOZONES OF CANADA

Compiled by
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Lands Directorate, Environment Canada



Ecological Land Classification Series, No. 19



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INTRODUCTION

This report presents a broad perspective on the country's natural resource base. The ecozones described represent large natural landscape units which contain distinctive sets of abiotic and biotic resources that are ecologically interrelated.

While the basic notions involved here follow the Canadian ecological land classification system, certain modifications have been introduced to adjust to a configuration suitable for the requirements of the State of the Environment (SOE) report (Environment

Canada and Statistics Canada, 1982). Many of these needs, and the restrictions which must accompany them, are discussed under the heading "Mapped Information".

This text and map highlight the basis for and general characteristics of ecozones, and provide a natural rather than a jurisdictional basis for environmental analysis and synthesis. Further technical and scientific review will be ongoing, as some information concerning the natural resources in some parts of Canada remains poorly studied, while for other areas, conflicting or unclear statements exist.

REGIONALIZATION IN CANADA

Regionalization is a method of reducing or eliminating details which do not, on the average, hold true over large areas. Canada's resource base has been regionalized in map form on various collective or individual environmental themes for specific purposes (Bailey et al., 1983). "Forest Regions of Canada" (Rowe, 1972), "Geological Provinces of Canada" (Douglas, 1970), "Physiographic Regions of Canada" (Bostock, 1970), "Wetland Regions of Canada" (Wetland Working Group, 1981), "Ecoclimatic Regions of Canada" (Zoltai et al., 1983) and "Ecoregions of Canada" (Crowley, 1967) are just a few of the many examples.

While various forms of regionalization are possible, they address different purposes and use dissimilar criteria in deriving and describing their basic units. For example, "Forest Regions of Canada" largely depicts the potential and climatically stable forest stands for a given area. To derive the spatial extent of these regions, one must ignore the existing stands which have resulted from disruptions such as frequent fires or extensive logging, and concentrate on what is the climatic potential, provided that all soil conditions are not extreme (e.g. not extremely rocky, not too wet, not too nutrient-rich). Under these concepts, the Hudson Bay Lowland would be included in the Boreal Forest Region since some of the better drained locales have characteristic boreal plant species. This approach has its own merits, but it would not indicate what type of plants may predominate as a result of the overall adjustment to the wetness and related conditions of this area. Other types of maps of forest cover or vegetation that indicate which species are present would have to be consulted if that particular kind of mapped information were required.

"Geological Provinces of Canada" provides another example. These provinces delineate distinctive geological units based on the bedrock's age and type. One assumption used in mapping the extent of these units is that the glacial drift or other kinds of overburden covering the earth's surface have not been taken into consideration. Therefore, one could not determine the degree or general type of soil cover. Again, an area such as the Hudson Bay Lowland would, for example, be referenced by the underlying bedrock (e.g. limestone, dolomite, salt and gypsum) rather than by the organic and marine deposits that cover most of the surface.

Although there is no single all-useful form of regionalization, the SOE report wanted a spatial basis which would depict natural regions that afforded opportunities for, or imposed constraints on, a broad spectrum of activities (e.g. forestry, agriculture, wildlife and urbanization). Based on these requirements and on the limitations of other existing forms of regionalization, the ecological land classification approach was adopted.

Ecological land classification is a process of delineating and classifying ecologically distinctive areas of the earth's surface (Environmental Conservation Service Task Force, 1981). Each area can be viewed as a discrete system which has resulted from the mesh and interplay of the geologic, landform, soil, vegetative, climatic, wildlife, water and human factors which may be present. The dominance of any one or a number of these factors varies with the given ecological land unit. This holistic approach to land classification can be applied incrementally on a scale-related basis from very site-specific ecosystems to very broad ecosystems. Ecozones (see Figure 1) represent large and very generalized ecological units. For further information concerning levels of ecological generalization, refer to Appendix 1.

Figure 1: Terrestrial Ecozones of Canada



ECOZONES

For SOE purposes, Canada is divided into 15 separate terrestrial ecozones. Appendix 2 provides a brief synopsis of the major characteristics associated with each of the mapped ecozones. This report also gives further details later. First, however, a brief explanation of ecozones and mapping is provided.

Ecozones are areas of the earth's surface representative of very generalized ecological units, based on the perception that the earth's surface is interactive and continuously adjusting to the mix of abiotic and biotic factors that may be present at any given time. This concept of an ecosystem is not restricted to any particular size, but instead the basic ecological land classification system forms a bridge between macro systems and small systems. The various orders of ecosystems are related in a hierarchy in which a lower order ecosystem is nested within a higher order one (see Figure 2). This hierarchy allows us to view

Canada's environment from a broad perspective or at a more detailed sub-unit level. Since each ecosystem consists of a distinctive assemblage of physical and biological characteristics (see Figure 3), responses to land uses or practices can be broadly determined.

Ecological land classification has been applied in more detail in various parts of Canada. While there is no consistent coverage for all of the country yet, these studies or related ones have provided key information in establishing the larger mosaic. Some examples include "Ecoregions of Alberta" (Strong and Leggat, 1981), "Les Écodistricts du Québec" (Gilbert *et al.*, 1981), "Ecological Land Regions, Saskatchewan" (Kabzems *et al.*, 1980), "Ecoprovinces of the Northwest Territories" (Wiken and Ironside, 1982), "Soil Landscapes of British Columbia" (Valentine *et al.*, 1978), the Land Resource Zones proposed by Marshall (1982), "Ecoregions of Yukon Territory" (Oswald and Senyk, 1977), and "Mapping the Site Regions and Landscape Districts of Ontario" (Hills, 1976).

Figure 2: Hierarchy of Ecological Land Classification

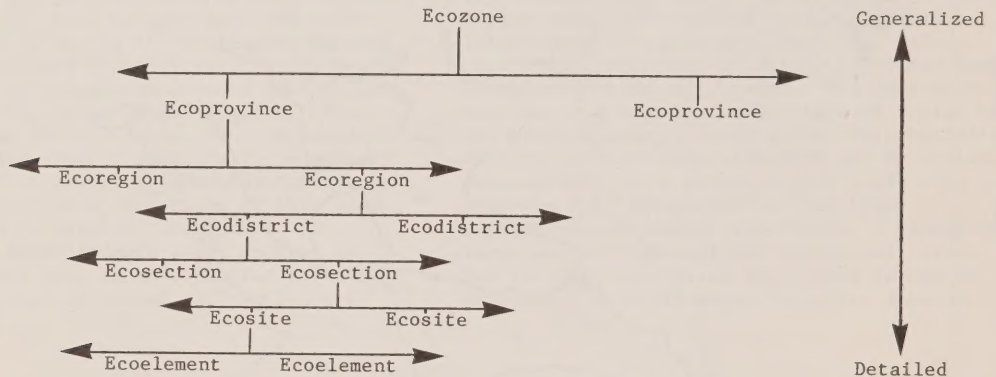


Figure 3: Ecozone Characteristics and Land Use Practices

NO.	ECOZONE	PHYSIOGRAPHY	VEGETATION	SOIL ORDER: SURFACE MATERIAL	CLIMATE	PRESENT USE
1.	Tundra Cordillera	Mountainous highlands	Alpine and arctic tundra	Cryosolic and brunisolic; colluvium, moraine, rock	Cold, semi-arid, subarctic	Trapping, hunting, recreation, tourism, mining
2.	Boreal Cordillera	Mountainous highlands; some hills and plains	Boreal; some alpine tundra and open woodland	Brunisolic; colluvium, moraine, rock	Moderately cold and moist montane	Hunting, trapping, forestry, recreation, mining
3.	Pacific Maritime	Mountainous highlands; some coastal plains	Coastal western and mountain hemlock	Podzolic; colluvium, moraine, rock	Very wet, mild, temperate maritime	Forestry, fishing, urbanization, agriculture
4.	Montane Cordillera	Mountainous highlands and interior plains	Mixed vegetation; conifer stands to sage brush fields	Luviosolic, brunisolic; moraine, colluvium, rock	Moderately cold and moist to arid montane	Forestry, agriculture, tourism, recreation
5.	Boreal Plains	Plains; some foothills	Conifer and broadleaf boreal stands	Luviosolic; moraine, lacustrine	Moderately cold, moist boreal	Forestry, agriculture, recreation, trapping
6.	Taiga Plains	Plains; some foothills	Open woodland; shrub lands and wetlands	Cryosolic, brunisolic; organic, moraine	Cold, semi-arid, subarctic to moist boreal	Hunting, trapping, recreation
7.	Prairie	Plains; some foothills	Short and mixed grasslands; aspen parkland	Chernozemic; moraine, lacustrine	Cool, semi-arid	Agriculture, urbanization, recreation
8.	Taiga Shield	Plains; some interior hills	Open woodlands, some arctic tundra and lichen heath	Cryosolic, brunisolic; moraine, rock	Moist, cold boreal to cold, semi-arid, subarctic	Hunting, trapping, recreation
9.	Boreal Shield	Plains; some interior hills	Conifer and broadleaf boreal stands	Brunisolic; moraine, rock, lacustrine	Cold, moist boreal	Forestry, mining, recreation, tourism
10.	Hudson Plains	Plains	Wetlands; arctic tundra and some conifer stands	Cryosolic; organic, marine	Cold, semi-arid subarctic to cold boreal	Hunting, trapping, recreation
11.	Mixed Wood Plains	Plains; some interior hills	Mixed broadleaf and conifer stands	Luviosolic; moraine, marine, rock	Cool to mild boreal	Agriculture, urbanization, recreation
12.	Atlantic Maritime	Hills and coastal plains	Mixed broadleaf and conifer stands	Brunisolic, luviosolic; moraine, colluvium, marine	Cool, wet temperate maritime	Forestry, agriculture, fishing, tourism
13.	Southern Arctic	Plains; some interior hills	Shrub-herb-heath arctic tundra	Cryosolic; moraine, rock, marine	Cold and dry arctic	Hunting, trapping, recreation, mining
14.	Northern Arctic	Plains and hills	Herb-lichen arctic tundra	Cryosolic; moraine, rock, marine	Very cold and dry arctic	Hunting, trapping, recreation, mining
15.	Arctic Cordillera	Mountainous highlands	Non-vegetated, some shrub- herb arctic tundra	Cryosolic; ice, snow, colluvium	Extremely cold and dry arctic	Hunting

MAPPED INFORMATION

Mapped information can frequently be misleading, unless the assumptions used and restrictions imposed are understood. For this report, the most important items to note are those related to the number of units, their purity or relative homogeneity, the nature of boundaries, and the defining criteria.

For ease of understanding and reporting, we tried at first to divide Canada into 12 units. These divisions were to cover terrestrial as well as aquatic areas. Approaching the number of units with the notion of isolating large ecological systems which would have some meaning in relation to varied human activity, it was difficult to reduce the list to much below 30. To reduce the number of units portrayed on a map, a convention termed "complexing" was used. This is simply a process of grouping units which might otherwise be considered as separate entities. The Northern Arctic Ecozone provides an example. Under different circumstances this would have been broken into two units --- one covering the environments associated with the sparsely vegetated upland hills and plateaux, and one covering the biologically richer lowland plains. In the Pacific Maritime Ecozone, the Pacific Ocean provides another example. This water body is a distinctive system quite apart from the continental mainland. However, here they have been combined. This aspect of complexing has obvious implications in regard to the purity of the selected ecozones.

Complexing is useful not only in linking broadly associated areas, but also in mapping certain natural regions which contain an arrangement or mosaic of parts that are extremely difficult to separate on a two-dimensional map. Mountainous settings are the most typical; they commonly have very different sets of environments interwoven in a pattern which is too often awkward to separate with ease. The Montane Cordillera Ecozone provides an illustration. Within this zone, at lower elevations and more southerly latitudes, the valleys display a desert or semi-desert environment. At higher elevations, alpine environments can dominate the mountain crests. In between these two environments, there are further layers and longitudinal bands of grassland, aspen parkland and montane forest. As this pattern is too intricate to separate on a small-scale map, these environments are considered together. The various elements depicted have relatively predictable geographic settings, and these are noted in the descriptions accompanying the map.

Variation of characteristics also results because of the generalization process. If the spatial extent of discrete ecosystems is small (usually less than 20%) relative to the larger unit, they become inclusions even if their characteristics are not similar to the overall unit. The boreal upland environment of the Cypress Hills, for example, became an inclusion in the Prairie Ecozone. Newfoundland is another example, as it is an inclusion in the Boreal Shield Ecozone. While this type of information is often lost on small maps, it can be recaptured by applying the more detailed levels of ecosystem classification, such as those of ecoregions or ecodistricts. In summary, the relative uniformity that one can expect within a given unit is partly a function of what type of mapping conventions have been applied: complexing for convenience; complexing because of intricate natural settings; and generalizing of atypical environments.

Definitive boundary lines (Figure 1) on maps often imply an equivalent degree of precision demarking one ecozone from its contiguous neighbour. If the cosmetic appearance of a map were not a concern, and if we could accurately delimit the various types of transitions between all units and all neighbours, the boundaries might be shown as bands of grey, and not necessarily of an even width. The boundaries can be tens to hundreds of kilometres wide, depending on the particular unit and with which neighbour the transition is taking place. The Taiga Shield Ecozone has a comparatively sharp boundary with its southeasterly neighbour --- the Hudson Plains. In contrast, the boundary with its more northerly unit --- the Southern Arctic --- is commonly less well defined, as the transition is gradual. With respect to boundaries, one should not expect to be able to step from one unit to another, or to find that the boundary surrounding a particular unit is the same at all points along that line, or even at closely situated points.

Conceptually, ecozones are "macro-order" ecosystems which possess characteristics which tend to cohere and endure in unity over the long term. While the number and kinds of shared characteristics must obviously be restricted due to the degree of abstraction associated with ecozones, they identify areas with similar kinds of properties. The descriptions of these mapped areas attempt to stress the predominant, the stable and the actual occurrences in that ecozone. These notions, along with the holistic focus, largely govern the criteria for delineating ecozones. To match the ecozone level of

generalization, equivalently generalized component classifications constitute the framework for focusing on the major ecosystem assemblages. Macro-climatic regimes, plant formations, major soil zones and first-order subcontinental landforms are examples of component classifications. Each of these components can be viewed as separate assemblages of spatial map units. Within these assemblages, the component pieces interact to produce the basic character or pattern of the unit. In certain ecozones, these separate components may criss-cross to a lesser or

greater degree along the edge. The mixed forest areas and the Canadian Shield areas in southeastern Ontario provide an example. In cases such as this, we placed the line more in accordance with the actual landform (e.g. Canadian Shield) than with the potential vegetation, because we felt that the landform characteristics would have a greater impact on a range of activities. A more detailed outline of the basic methodology, concepts and techniques is given in various publications (Bailey et al., 1983; Wiken et al., 1981; Welch et al., 1980; Wiken, 1980).

ECOZONE DESCRIPTIONS

The following gives brief descriptions of each of the 15 ecozones. Each description highlights a number of the biological and physical characteristics which are associated with that ecozone. Each ecozone is described by its major component features, the typical order for these being physiography, climate, soils, vegetation, wildlife and, often, water-related items. The material has been adapted largely from existing studies of the Canadian landscape as noted in the cited literature.

1. Tundra Cordillera

This ecozone is located along the northern extent of the Rocky Mountain system. It covers segments of the Yukon Territory and the southwestern portion of the Northwest Territories. In several respects, it possesses some of the features associated with the more southerly Boreal Cordillera and the more northerly Arctic Cordillera ecozones. It is well known for its wilderness areas and recreation activities.

Steep, mountainous topography, consisting of repetitive, sharply etched ridges and narrow valleys, predominates, with foothills and basins also present. The bedrock is largely sedimentary in origin, with minor igneous bodies. Much of the area is mantled with colluvial debris, with frequent bedrock exposures and minor glacial deposits. The northwest portion of this ecozone consists of unglaciated terrain and residual soils.

The climate is generally dry and cold. Total precipitation averages about 300 mm per year. This increases to between 700 and 800 mm per year in the mountains of the south-central part of this ecozone. Winters are long and cold with very short daylight hours; summers are warm to cool with extended periods of daylight. The average annual growing season is about 70 days or ranges between 750 and 1000 growing degree-days above 5°C. The average annual number of frost-free days ranges from 20 to 60; however, frost can occur on every day of the year. The mean daily January temperature ranges from -25 to -30°C, with the mean daily July temperature ranging from 12 to 15°C. Weather patterns from the Arctic and Alaskan coasts have a marked influence on this ecozone.

Brunisols, Regosols and Cryosols tend to be the predominant soils, the latter being a marked result of the subarctic climate. These soils support plant associations typical of arctic tundra (cottongrass, dwarf or low shrubs,

mosses and lichens), alpine tundra (mountain avens, saxifrages, dwarf shrubs and lichens), and some open woodland or taiga (white spruce, white birch, medium-height to low shrubs, and mosses or lichens). The arctic tundra formations are more common in the north, the alpine tundra in areas of higher elevations, and the taiga in the south. Taiga is associated with the more weathered and warmer soils (Brunisols). Abundant permafrost features, such as peat hummocks, palsas and peat plateaux, are common in organic soils.

Wildlife in the area is diverse. Characteristic mammals of the Tundra Cordillera Ecozone include Dall's sheep, woodland and barren-ground caribou, moose, mountain goat (in the southern portion), black and grizzly bears, wolf, marten, lynx, arctic ground squirrel, American pika, hoary marmot and brown lemming. The summer and winter ranges of the Porcupine caribou herd are also linked closely with the northwestern portion of this unit. This ecozone also contains the largest existing concentration of wolverine. Gyrfalcon, willow ptarmigan and rock ptarmigan are representative bird species. Waterfowl (e.g. canvasback, greater and lesser snow geese, mallard) use parts of this area for summer breeding and nesting sites.

Much of the area remains a wilderness, and most of man's activities are confined to hunting, trapping, tourism and outdoor recreation. Mining and hydrocarbon deposits are also present, and some of these have been exploited.

2. Boreal Cordillera

This ecozone is located in the mid section of the Canadian Rocky Mountain system. It covers sections of northern British Columbia and the southern Yukon Territory. It is well known for its forestry, recreation and mineral resources.

Physiographically, the area is generally characterized by two units --- the mountain ranges which contain numerous high peaks and extensive plateaux, and the intermontane plains. These have been modified as a result of glaciation, erosion, solifluction, and aeolian and volcanic ash deposition. Glacial drift, colluvium and outcrops constitute the main surface materials. A small portion of this ecozone in the northwest was unglaciated.

The climate is typified by long, cold winters and short, warm summers. The mean annual

temperature is below freezing. January is usually the coldest month and July the warmest, although highest maximum temperatures may occur in August. The mean daily January temperature ranges from -15 to -27°C, with the mean daily July temperature ranging from 12 to 15°C. Precipitation is about 400 mm per year over much of the intermontane plateau areas; it is extremely high on the mountains in the west and ranges from about 1000 to 1500 mm on the mountains in the east. The average annual growing season ranges from 750 to 1000 growing degree-days above 5°C. The average annual number of frost-free days ranges from 20 to 60. The Pacific maritime influence is responsible for the highest proportion of precipitation, which occurs generally in the fall.

Perennially frozen ground (permafrost) and associated landscape features tend to be widespread in the more northerly areas and at higher elevations; soils are Cryosols. In the warmer, somewhat moister lower elevations in the southern half, Brunisols, Podzols and Luvisols are common.

The vegetation for this section is typical of the Boreal Forest. Trees form closed to open canopies over much of the plateaux and valleys. Tree species include white spruce, black spruce, alpine fir, lodgepole pine, trembling aspen, balsam poplar and white birch. In the northwest the stands are generally open, and lodgepole pine and alpine fir are usually absent. Alpine tundra is prevalent at higher elevations, with sedge-dominated meadows and lichen-colonized rock fields being common.

Characteristic mammals of the Boreal Cordillera Ecozone include woodland caribou (in the northern half of the area), moose, Dall's sheep, mountain goat (in the southern half), black and grizzly bears, marten, lynx, American pika, hoary marmot and arctic ground squirrel. Representative bird species include willow, rock and white-tailed ptarmigan, and spruce grouse.

The forest, mineral and large river system resources have fostered forestry, mining and hydroelectric developments. Tourism and recreation activities are also present.

3. Pacific Maritime

As the name implies, this ecozone includes the land margin along the entire Pacific Coast, as well as the marine portion. It is well known for its forest and fish resources, mountainous topography and maritime-moderated climate.

Mountainous topography dominates, cut through by numerous fjords and glacial valleys and bordered by coastal plains along the ocean margin. Igneous and sedimentary rocks underlie most of the area. Colluvium and glacial deposits are the main surface materials.

This ecozone has some of the warmest and wettest climatic conditions in Canada. This maritime-moderated climate receives as little as 600 mm of precipitation per year in the lower Georgia Strait, while the overall area is typically much wetter, receiving up to 3000 mm. There is generally relatively little variation between the mean monthly temperatures, compared to elsewhere in Canada: average July temperatures are in the 12 to 18°C range, while average January temperatures are a relatively warm 4 to 6°C. The frost-free period is up to 220 days in the most southerly valleys, decreasing to about 100 days in mountainous regions. The average annual growing season is up to 2000 growing degree-days above 5°C in most southerly valleys and 1500 to 1750 growing degree-days in mountainous regions. The Pacific maritime influence is responsible for the high proportion of precipitation and for the temperature moderation.

The soils are largely Podzols, with Brunisols and Folisols common. The western coastal forest is composed mostly of western red cedar, western hemlock, Douglas fir, mountain hemlock, amabilis fir, Sitka spruce, yellow cedar and alder. Douglas fir is confined largely to the extreme southern portion of the area. In the north, amabilis fir becomes more common. Mountain hemlock is usually associated with higher elevations.

Characteristic mammals of the Pacific Maritime Ecozone include white-tailed deer, black and grizzly bears, mountain lion, fisher, raccoon and American pika. Bird species unique to this area include black oyster catcher, California and mountain quail (both in the southern portion only), tufted puffin and chestnut-backed chickadee. Other representative birds are pygmy owl, Steller's jay and northwestern crow. Marine environments are typified by northern sea lion, northern fur seal, harbour seal, giant beaked whale, sperm whale, grey whale, killer whale, Pacific pilot whale and blue whale. The sea otter is an endangered species which has been reintroduced to the northwest coast of Vancouver Island. Salmon and associated spawning streams are located throughout this ecozone.

A narrow continental shelf and slope are associated with much of these ice-free coastal waters. Towards the southern end of Vancouver Island, the deep water upwelling encourages a rich oceanic environment. Throughout the ecozone, freshwater discharge from coastal rivers mixing with ocean waters also stimulates the occurrence of abundant marine life.

Currently, most of the land is linked to forest harvesting. Environmental conditions for much of the region are optimal for the growth of conifers. Forest productivity is the highest in the country, and commercial forest enterprises are a major activity. The lowlands of the Fraser Valley and the southeastern tip of Vancouver Island possess the area's main expanse of highly productive agricultural soils, as well as urbanized lands. The interface of these two in particular has led to various land planning issues and concerns. The fishing and shipping industries are also integral activities.

4. Montane Cordillera

Most of southern British Columbia and a portion of southwestern Alberta are contained within this ecozone. The diversity of environments makes it one of the most striking of the 15. It is well known for its forest and mineral resources, recreational use and hydroelectric developments.

Physiographically, it is essentially a rugged mountainous unit which rings several major interior plains. The plains are more extensive to the north and finger out as intermontane valleys towards the southerly half. Much of these consists of glacial moraine and, to some degree, fluvial and lacustrine deposits, while the mountains consist largely of colluvium and outcrops.

The climate is typified by moderately long, cold winters and short, warm summers. Annual precipitation is about 800 mm over much of the northern section, 1200 mm along the British Columbia-Alberta border, and only 500 mm in the desert-like environments towards the Canada-U.S. border. The mean daily January temperature ranges from -7.5 to -17.5°C , with the mean daily July temperature ranging from 13 to 18°C . The average annual growing season ranges up to, and can exceed, 2000 growing degree-days above 5°C in the southern region and is approximately 1000 to 1250 growing degree-days in the northern portion. The average annual number of frost-free days ranges from 100 to 140 in the south and from 50 to 80 in the north. Moist Pacific air and the effect of orographic rainfall control the precipitation pattern.

The higher elevations support subalpine and alpine environments. In southwestern Alberta, these environments occur at elevations usually greater than 1500 m; in eastern British Columbia, they occur above 1100 m; and to the north, these environments occur at successively lower elevations and become continuous across upper mountain slopes and the intervening valleys. The alpine environment contains various herb, lichen and shrub associations, while the subalpine environment has tree species such as lodgepole pine, alpine fir and Engelmann spruce. With decreasing elevation, the vegetation of the mountainous slopes and rolling plains separates into three general groups: a marginal band of forests characterized by Engelmann spruce, alpine fir and lodgepole pine; in much of the north, northwest and central portions, forests characterized by ponderosa pine, interior Douglas fir, lodgepole pine and trembling aspen; and the forests in the southeast, characterized by western hemlock, western red cedar, interior Douglas fir and western white pine.

Luvisols and Brunisols are the most common soils, with Podzols occurring throughout the mountainous terrain in the east. The soils of the lower valley floor of the plains to the south are often Chernozems and support grasslands. These grade into desert-like environments towards the Canada-U.S. border.

Characteristic mammals of the Montane Cordillera Ecozone include woodland caribou, mule deer, moose, wapiti (mainly in parks in the area), mountain goat, bighorn sheep, coyote, black and grizzly bears, fisher, badger, striped skunk, mountain lion, American pika, hoary marmot and Columbian ground squirrel. Typical bird species include blue grouse, Steller's jay and black-billed magpie.

Commercial forest operations have been established in many parts, particularly in the northern interior sections. In the eastern Rockies and Columbia Mountains, however, national and provincial parks have been established for recreational use or as reserves for wildlife habitat. It is mainly in the valleys that areas have been improved for range or are dry-farmed for grains; near streams where water is available for irrigation, row crops and hay are grown. The southern valleys are nationally important for their orchards and vineyards. Major hydroelectric developments are also associated with rivers such as the Columbia, Kootenay and Nechako.

5. Boreal Plains

The Boreal Plains Ecozone extends as a wide band from the Peace River country of British Columbia in the northwest to the southeastern corner of Manitoba. It differs markedly from the Boreal Shield Ecozone, which is more bedrock controlled and contains numerous outcrops and lakes. It is well known for its forest resources and northerly agricultural activity.

The physical features of this unit are similar to those of the Prairie Ecozone to the south. The surface is a nearly level to gently rolling plain, consisting largely of glacial moraine and lacustrine deposits. These materials are usually deep and tend to mask the underlying sedimentary topography. Vegetative and soil characteristics distinguish this area from its southern neighbour and these differences tend to be the result of the somewhat cooler and moister climate of this ecozone.

The moist climate is typified by cold winters and moderately warm summers. Precipitation is about 400 mm over much of the ecozone, nearing 500 mm along the southern boundary. The mean daily January temperature ranges from -17.5 to -22.5°C, with the mean daily July temperature ranging from 12.5 to 17.5°C. The average annual growing season ranges between 1000 and 1250 growing degree-days above 5°C. The average annual number of frost-free days ranges between 80 and 130. This ecozone is within the rainshadow of the moist Pacific orographic rainfall pattern and is also influenced by continental climatic conditions.

White and black spruce, jack pine and tamarack are the main conifer species. Nevertheless, there is a wide distribution of broadleaf trees, particularly white birch, trembling aspen and balsam poplar. These latter species, particularly the trembling aspen, are most numerous in the transitional section leading to the prairie grasslands. Black spruce and tamarack increase in dominance along the more northerly sections of the ecozone.

The soils of this ecozone are largely Luvisols. These grade southwards into Black Chernozems and northwards into Brunisols and Organics.

Characteristic mammals of the Boreal Plains Ecozone include woodland caribou, mule deer, white-tailed deer (in the southern portions), moose, wapiti (locally), bison (in park herds), coyote, black bear, marten, fisher, lynx and least chipmunk. Representative birds include boreal owl, great horned owl, blue jay, rose-breasted and evening grosbeaks, franklin's gull and brown-headed cowbird. Wood bison are

an endangered species in this ecozone; most are contained within federal park reserves.

Agricultural development has made some inroads into the southerly and northwesterly fringes. However, the principal use of this region is associated with the preservation of forest vegetation as a sustaining resource, and with oil and gas exploration and production. Hunting and trapping are also continuing activities.

6. Taiga Plains

The Taiga Plains are mainly located in the southwesterly corner of the Northwest Territories; however, they also extend into northeastern British Columbia and the upper margin of Alberta. Second only to the Hudson Plains Ecozone, they have a large percentage of organics and wetlands.

This unit is largely composed of nearly level to gently rolling plains covered with organic materials and, to a lesser degree, glacial moraine and lacustrine deposits. A large portion of the area is underlain by permafrost, and this acts to perch the surface waters and promote a regional overland seepage system. When combined with low-angle slopes, it creates a landscape which is seasonally waterlogged over large areas. Patterned ground features are common.

The climate is semi-arid and cold. Annual precipitation ranges from about 400 mm in the south to about 200 mm in the north. The mean daily January temperature ranges from -22.5 to -30°C with the mean daily July temperature ranging from 10 to 15°C. The average annual growing season ranges from 1000 growing degree-days above 5°C in the south to about 750 in the north. The average annual number of frost-free days ranges between 60 and 100. Winters are generally long, and cold arctic air influences the area for most of the year.

The cool temperatures, the widespread permafrost and poor drainage create favourable conditions for Cryosolic, Gleysolic and Organic soils. The arctic tundra meadow and wetland plant associations which prevail over much of this area reflect these conditions. Dwarf birch, labrador tea, willows, bearberry, mosses and sedges are associated with this environment. Upland and foothills areas and southerly locales tend to be better drained, warmer and support mixedwood forests characterized by white and black spruce, tamarack, white birch, trembling aspen, balsam poplar and lodgepole pine.

Characteristic mammals of the Taiga Plains Ecozone include moose, woodland caribou, bison (in park herds), wolf, black bear, marten, lynx and arctic ground squirrel. Representative bird species include red-throated loon, northern shrike, sharp-tailed grouse, fox sparrow and common redpoll.

Hunting and trapping are the primary human activities. Some forestry, mining and oil/gas activities are also carried out.

7. Prairie

The Prairie Ecozone, like the Mixed Wood Plains unit, should be considered as a culturally molded ecosystem. Man has substantially modified the "natural" system and now is one of the major controlling agents in altering and sustaining processes which affect the inherent nutrient, hydrologic and food chain cycles. However, as in the past when they were the primary factors in encouraging both native grasslands and Chernozemic soils, the warm, arid climate and the deep soils of the plains continue to be overall controlling agents which influence the extensive cereal grain practices today.

The Prairie Ecozone has long been termed the "bread basket" of Canada. It occupies the south-central grain production area of the Prairie provinces. This semi-circular area has its base on the Canada-U.S. border and arcs from the western edge of Alberta to the eastern edge of Manitoba. While this ecozone is frequently thought of as undisturbed grassland, most of it has been altered by man's agricultural and urban activities. This makes it difficult to recognize the natural zonations and limits.

This unit consists largely of glacial moraine and lacustrine materials. The topography of the plains varies from nearly level to rolling terrain.

The northern edge of this ecozone is associated with groves of trembling aspen and balsam poplar and Black Chernozemic soils. With their high content of organic matter, deep profiles and inherent nutrient status, the Chernozems are regarded as among the best agricultural soils in Canada. Climatic characteristics include over 400 mm of precipitation annually, mean daily January temperatures of -22.5 to -25°C and mean daily July temperatures of 15 to 17.5°C , 1000 to 1250 growing degree-days above 5°C , and 80 to 100 mean annual frost-free days. Because of these favourable climatic and soil conditions, grain yields, particularly those

of wheat, are higher and more reliable than in other grassland areas. Such favourable conditions have encouraged a related but more diverse agricultural industry in which livestock and dairy products are significant to farm incomes.

To the south, slightly drier conditions (350 to 400 mm of precipitation annually) and a higher moisture deficit (150 to 255 mm) have given rise to a mixed-grass environment. Other climatic characteristics include mean daily January temperatures of -10 to -17.5°C and mean daily July temperatures of 17.5 to 20°C , 1500 to 1900 growing degree-days above 5°C , and 80 to 110 mean annual frost-free days. The relatively high natural fertility and good moisture holding capacity of the area's Dark Brown Chernozems make it highly productive for agriculture. Relatively flat topography is particularly conducive to highly mechanized farming.

The short-grass prairie setting, which constitutes the inner and more southerly arc of this ecozone, is less productive. It is the driest area, where less than 350 mm of precipitation falls annually. Other climatic characteristics include mean daily January temperatures of -15 to -17.5°C and mean daily July temperatures of 15 to 17.5°C , and 1000 to 1500 growing degree-days above 5°C . The long frost-free period (about 110 days) and high temperatures in early spring result in high evapotranspiration and make the moisture less available for plants. In the mixed-grass crescent, however, cooler spring temperatures delay the snow melt and evapotranspiration.

Characteristic mammals of the Prairie Ecozone include mule and white-tailed deer, wapiti (locally), and coyote. Distinctive species in this ecozone include pronghorn (in the south-central portion), badger, white-tailed jack rabbit, Richardson's ground squirrel and northern pocket gopher. Unique bird species include ferruginous hawk (a threatened species), greater prairie chicken (an endangered species), sage grouse, American avocet and burrowing owl (a threatened species). Great blue heron, black-billed magpie, Baltimore oriole, veery and brown thrasher are other representative birds. This is also a major waterfowl staging and nesting habitat.

Agriculture, urbanization and recreation are the primary human activities carried out in this ecozone.

8. Taiga Shield

This ecozone is an area marked by bedrock

outcrops. Like the Southern Arctic Ecozone, it lies on either side of Hudson Bay. The eastern segment occupies the central part of Quebec and Labrador, and a western segment occupies portions of northern Manitoba, Saskatchewan and the south-central area of the continental Northwest Territories.

Most of this unit consists of rolling or undulating plains. Precambrian outcrops and mantles of glacial moraine are the main surface materials. Some lacustrine and marine deposits are also present. Permafrost is discontinuous but widespread and acts to promote lateral rather than vertical drainage. For this reason, low areas between individual hills or knolls are commonly waterlogged or wet for prolonged periods. This unit, as with most of the Canadian Shield, is dotted with a mosaic of lakes.

Soils are predominantly Brunisols in the southern portion and Cryosols in the northern portion, with a mix of the two in the centre of the ecozone. Gleysols occur in some poorly drained situations.

The climate is subarctic continental. Precipitation is low (from 175 to 200 mm annually), and temperatures are cool to cold. The mean daily January temperature ranges from -17.5 to -27.5°C with the mean daily July temperature ranging from 7.5 to 17.5°C. The average annual growing season ranges from 500 growing degree-days above 5°C in the north to 1000 in the south. The average annual number of frost-free days ranges between 70 and 100. Summers are relatively short with prolonged periods of daylight, while winters are the reverse.

Along the northern edge of this ecozone, the poleward limits of tree growth are reached. The forest stands are open and form lichen woodlands which merge into areas of open arctic tundra. This northern interface with the tundra setting of the Southern Arctic Ecozone is often diffuse and variable owing to outcrops and to shallow or wet soils. The central portion contains relatively unproductive and commonly stunted coniferous and deciduous stands, including open, stunted black spruce, accompanied by alders, willows and tamarack in the fens and bogs, and open, mixedwood associations of white spruce, balsam fir (in the Quebec portion), trembling aspen, balsam poplar and white birch in upland sites and along rivers and streams.

Characteristic mammals of the Taiga Shield Ecozone include barren-ground and some woodland caribou, moose, wolf, snowshoe hare, arctic fox, black and grizzly bears and lynx.

Representative birds include arctic and red-throated loons, northern phalarope, northern shrike, tree sparrow and grey-cheeked thrush. In the marine environment, representative species include walrus and bearded, harbour and ringed seals.

This ecozone is generally unproductive for forestry, although there are a few favourable locales where some local forestry practices are feasible. The mosaic of open woodlands and tundra interstices provides partial summer and winter range for species such as caribou.

9. Boreal Shield

The Boreal Shield Ecozone is a broadly "U"-shaped zone that extends from northern Saskatchewan east to Newfoundland, passing north of Lake Winnipeg, the Great Lakes and the St. Lawrence River. It is well known for its forest, mining and recreational resources.

Like the Taiga Shield Ecozone, this area is dominated by rolling terrain with Precambrian outcrops interspersed with mantles of glacial moraine. The morainal areas generally support closed stands of conifers, largely white and black spruce, balsam fir and tamarack. Towards the south, there is a wider distribution of broadleaf trees, such as white birch, trembling aspen and balsam poplar, and needle-leaf trees such as white, red and jack pine.

Soils range from Podzols in the south to Brunisols in the north. Throughout the contrasting areas of exposed bedrock, this mosaic of soils and non-soils tends to be covered with a range of communities dominated by lichens, shrubs and forbs. Small to medium-sized lakes are common --- a characteristic not shared with the Boreal Plains Ecozone to the west.

Climatic conditions vary slightly over the area. This ecozone is largely influenced by cold Hudson Bay air masses, which are also responsible for relatively high levels of precipitation, 400 mm in the west to 1000 mm in the east. Mean daily January temperatures are -10 to -20°C, while mean daily July temperatures average 15 to 18°C. The average annual growing season ranges from 1000 growing degree-days above 5°C in the north to 1500 in the south. The average annual number of frost-free days ranges between 60 and 100, with some regions having less than 40.

Characteristic mammals of the Boreal Shield Ecozone include woodland caribou, white-tailed deer, moose, black bear,

raccoon, marten, fisher, striped skunk, lynx, bobcat and eastern chipmunk. Representative birds include boreal owl, great horned owl, blue jay and evening grosbeak. In the Atlantic marine environment, typical mammals are the grey, harp and hooded seals, and the northern bottlenosed, sperm, killer, Atlantic pilot, fin and blue whales. The bowhead whale, an endangered species, and the humpback whale, a threatened species, are both found in this unit.

Principal related activities in this zone include forestry, mining, limited agriculture, hunting, trapping and recreation.

10. Hudson Plains

Canada's wetlands are quite varied and are used for peatland energy sources, wildlife habitats, watershed recharge and filtration systems, and agricultural development. Although wetlands are distributed throughout the nation, the largest extensive area is associated with the Hudson Plains Ecozone --- an area centred in northern Ontario that extends into northeastern Manitoba and western Quebec. The wetlands which dominate this coastal plain are covered with large areas of muskeg or marshes. The overall character of some sites associated with the drier and much less frequent upland rises suggests that the climatic regime here is similar to those of the Boreal Plain and Boreal Shield ecozones; the net result of the ecosystem, however, is actually different because of other interacting components. Here, the regionally high water table, the underlying permafrost, the maritime climatic influence and the low-relief coastal plain are just a few of the factors which combine to produce a colder and wetter environment than might be expected.

The unit is composed of broad, poorly drained lowlands which have a gentle slope gradient. Elevations seldom exceed 500 m. The surface is primarily mantled by expansive peatland complexes. A minor component of raised beaches and river deposits is also present.

Climatically, this ecozone is heavily influenced by the cold and moisture-laden Hudson Bay-low and Polar-high air masses. It is generally a cold continental climate with moderate precipitation of 400 to 700 mm annually. Mean daily January temperatures are about -19°C, while mean daily July temperatures hover between 12 and 16°C. The average annual growing season ranges from 500 growing degree-days above 5°C in the north to 1000 in the south. The average annual number of frost-free days ranges between 70 and 100.

Due to poor drainage, Organic Cryosol soils

predominate. These nutrient-deficient and highly acidic soils do not promote good forest growth; in fact, most of this area is treeless. In the lakes, low productivity for freshwater fish results from low temperatures and poor nutrient conditions. The vegetation associations consist of arctic tundra and some boreal forest transition types. The poorly drained areas support dense sedge-moss-lichen covers, and the less frequent and better drained locales support open woodlands of black spruce and tamarack.

Characteristic mammals of the Hudson Plains Ecozone include woodland caribou, moose (in the northwest and southeast), black and polar bears, marten, arctic fox and fisher. A variety of waterfowl typifies the birds. The ecozone is, for example, a major habitat for substantial populations of breeding waterfowl, especially Canada geese. In the marine environment, representative mammals include walrus and bearded, harbour and ringed seals. Saltwater bay areas are considered to be important summer habitat for beluga and bowhead whales, as well as harbour and ringed seals.

Man's activities are generally limited to native hunting and trapping. This is also an important area for wildlife (especially waterfowl) conservation.

11. Mixed Wood Plains

Covering the Lower Great Lakes-St. Lawrence Valley areas, this ecozone is among the smallest. However, its combination of agricultural soils, gentle topography and relatively warm summer climate have caused this unit to be one of the most intensively used and highly populated.

Nearly level to rolling plains extend throughout this area; they are composed of various moraine, marine and lacustrine deposits.

In the northern portion of this ecozone, the predominant soils are Podzols, Luvisols and Brunisols. In southern Ontario, near the Windsor area, soils tend to be predominantly Luvisols, Brunisols and some Gleysols.

The climate is continental, typified by warm summers and cool winters. The weather, however, is highly changeable in this region, since it lies within one of the major storm tracks of North America. Mean daily July temperatures are 18 to 22°C, while mean daily January temperatures are -3 to -12°C. The area receives approximately 720 to 1000 mm of precipitation annually. The average annual growing season, north to south, ranges from 1750 to 2500 growing degree-days above 5°C. The average annual number of frost-free days ranges between 120 and 180.

At one time heavily forested, very little of the original forest remains today, especially in the southern portions. Much of the area is heavily settled, and the forest vegetation is often reduced to farm woodlots, hedgerows and remnant stands. Modification of both original and introduced vegetation has been further intensified by the rapid spread of urban and industrial development into rural areas.

The forest in the northern portion of this ecozone is mixed coniferous-deciduous, dominated by white and red pine, eastern hemlock, oaks, maples and birches. The forest stands in this area are likely to contain commercial timber sources. A small part of the deciduous forest, widespread in the eastern United States, continues northwards into southeastern Ontario near the Detroit-Windsor area. It covers the climatically warmest portions of the ecozone in Ontario. Species which were previously abundant include sugar maple, beech, white elm, basswood, and red and white oaks.

Characteristic mammals of the Mixed Wood Plains Ecozone include white-tailed deer, black bear, raccoon, striped skunk, eastern cottontail, eastern chipmunk, and grey and black squirrels. The grey fox, a rare species in Canada, is found in this ecozone. Representative birds include great blue heron, red-shouldered hawk, whip-poor-will, red-headed woodpecker, blue jay, eastern bluebird and Baltimore oriole. A rare species, the Caspian tern, breeds in this unit. Other birds, such as the bobwhite, the cardinal, Carolina wren and green heron, are unique to this area.

This ecozone includes four of the Great Lakes --- Huron, Erie, Superior and Ontario --- important aquatic ecosystems in their own right. They remain important shipping corridors and recreation areas, and they supported a strong fishery industry in the past. Erosion of coastal bluffs and pollution of waters are continuing problems.

Clearing and development for farming have greatly modified much of this ecozone. Some of this cleared land, especially to the north, was only marginally productive and has been abandoned to a returning forest. In the south, however, most of the area cleared of its natural cover has remained productive for farming. Where these areas are adjacent to urban centres, pressures to convert farmland to residential and industrial uses are intense.

12. Atlantic Maritime

The Atlantic Maritime Ecozone extends from the mouth of the St. Lawrence River southeasterly across New Brunswick, and into Nova Scotia and Prince Edward Island. The proximity of the ocean has a major impact on the characteristics of this ecozone. It is well known for its fish, agricultural and forest resources.

The unit is dominated by the interior Appalachian upland and the Northumberland coastal plain. The uplands of New Brunswick and Nova Scotia are composed of granite, gneiss and other hard, crystalline rocks. Rough terrain, scarred by glacial features, and poor soils have tended to discourage farming and extensive settlement. The coastal lowland areas, with their deeper soils derived from marine deposition and glacial erosion of the underlying sedimentary bedrocks (e.g. sandstones, shales and limestone), accommodate the greater proportion of the population in this unit and its agricultural activities.

The Atlantic Ocean and its current have created a moderating and cool-moist maritime climate. Mean annual precipitation ranges from 1000 mm inland to 1425 mm along the coast. The winter and summer temperatures (mean daily January temperature between -2.5 and -10°C and mean daily July temperature of about 18°C) are moderated by the ocean, but this effect decreases with higher elevations, such as in the Cape Breton and New Brunswick highlands. The average annual growing season ranges from 1500 to over 1750 growing degree-days above 5°C. The average annual number of frost-free days ranges from 80 in the New Brunswick highlands to 180 along the coast.

The dominant soils of the area are Podzols and Luvisols, although scattered areas of other types also occur. Soils which evolved from glacial scouring in the uplands are usually shallow, leached, stony, and relatively unsuitable for agriculture. Forest growth is, however, fairly productive here, except where the bedrock is exposed. The thicker and somewhat more fertile lowland soils support an agricultural industry that includes dairy, beef and poultry production, and the growing of vegetables and fruits.

Forest stands are mixed coniferous-deciduous, characterized by red spruce, balsam fir, yellow birch and sugar maple, with red and white pine and eastern hemlock occurring to a lesser but significant degree. Some boreal species are present, including black and white spruce, balsam poplar and white birch. Jack pine is prominent on sandy soils and in

areas of regrowth after fires.

Characteristic mammals of the Atlantic Maritime Ecozone include white-tailed deer, moose, black bear, raccoon, striped skunk, bobcat and eastern chipmunk. Representative birds include whip-poor-will, blue jay, eastern bluebird and rose-breasted grosbeak. In the marine environment, representative species include grey seal, hooded and harp seals (both in the northern portion only), and Atlantic pilot, killer, and northern bottlenosed whales.

The coastline is predominantly rocky. The continental shelf averages 200 km in width and usually has a depth of less than 200 m. The size of the shelf and the mixing of currents produce a nutrient-rich environment which encourages a very productive fishing and shellfish industry.

Forestry and agriculture are the major land-oriented activities. Lowland agriculture is important for providing fruits and vegetables as cash crops, while forestry is the principal industry in the more rugged upland areas. Hydroelectric projects are becoming more common on the many rivers that drain the highlands, especially in New Brunswick. In addition, the natural beauty of the interior and coastal environments supports an important tourist industry.

13. Southern Arctic

The land portion of this ecozone, like the Taiga Shield Ecozone, is split by Hudson Bay into east and west portions. The Bay is included within this unit as a marine environment. The larger land portion covers the mainland of the Northwest Territories and the smaller eastern segment bridges northern Quebec and Labrador.

The terrain consists largely of strongly rolling lowland plains. Much of it is mantled by glacial moraines, except near the coasts where fine-textured marine materials cover the surface. Throughout, there are exposures of bedrock; most of the outcrops belong to the Precambrian Shield group. Lakes are very common.

The climate is typically arctic with long, cold winters and short, cool summers. The short summer growing season is enhanced by long periods of daylight; however, mean daily July temperatures tend to be cool (about 10°C). Winter temperatures are highly variable, but the mean daily January temperature tends to be about -30°C. Mean annual precipitation north-south ranges

between 200 and 400 mm. The average annual growing season north-south ranges from 250 to 750 growing degree-days above 5°C. The average annual number of frost-free days ranges north-south from 40 to 80.

Cryosolic soils predominate. These soils have continuous permafrost layers and usually are moist or wet throughout the summer. Although the degree of thaw in the surface is limited, it tends to be greater along the southern fringe and decreases to the north.

The Southern Arctic Ecozone represents a major area of vegetation transition, as most of the ecozones which lie to the south are treed. This unit contains the major shrublands in the tundra. The size of shrubs decreases rapidly as one moves north, with very low and flattened plants being most characteristic of the northern and central locales. Typical shrubs include dwarf birch, willows and heath species; these are commonly mixed with various herbs and lichens. Wetlands are common in the low-lying areas, mainly supporting sedge-moss covers.

Characteristic mammals of the Southern Arctic Ecozone include moose (in the northwestern and southeastern portions), muskox (in the north-central portion), wolf, arctic fox, grizzly and polar bears, arctic hare, arctic ground squirrel, and brown and collared lemmings. The area also includes the major summer and calving grounds of two of the largest caribou herds, the barren-ground in the west and the woodland caribou in the east. The area is also a major breeding and nesting ground for a variety of birds. Representative species include yellow-billed, arctic and red-throated loons, whistling swan, snow goose, oldsquaw, gyrfalcon, willow and rock ptarmigan, northern phalarope, parasitic jaeger, snowy owl, hoary redpoll and snow bunting. In the marine environment, typical species include walrus, grey, harp, bearded, harbour and ringed seals, beluga whale, narwhal, and sperm and northern bottlenosed whales. The endangered bowhead species is found in this ecozone.

This ecozone includes three main marine areas --- the Beaufort Sea, Hudson Bay and Labrador Sea. The Beaufort and Hudson areas possess shallow and gently inclined continental shelves which attain a depth of about 200 m. Like Davis Strait, these areas are under fast ice for most of the year. During the short summer, pack ice or icebergs remain offshore. Within Davis Strait, the currents circulate cold water counter-clockwise, northwesterly along Greenland and southeasterly along Baffin Island towards Labrador.

Native hunting and trapping are the primary land-oriented activities. The mineral and petroleum potential of the area has also led to significant exploration and extraction activity.

14. Northern Arctic

The Northern Arctic Ecozone extends over most of the non-mountainous areas of the Arctic Islands and portions of northeastern Keewatin District and northern Quebec. Due to a combination of soil, bedrock and climatic features, the terrestrial areas are more biologically impoverished than those of the Southern Arctic Ecozone; the marine environments, however, are more varied.

Physically, the western portion consists mostly of lowland plains covered with glacial moraine. Marine deposits and bedrock outcrops are also common in certain locales. East of a longitudinal line which runs between Prince of Wales and Somerset islands, the terrain tends to be uplands consisting of plateaux and rocky hills.

The climate is typical of the High Arctic, being very dry and cold. The annual precipitation ranges from 100 to 200 mm; mean daily January temperatures range from -30 to -35°C in the long winters and mean daily July temperatures are between 5 and 10°C in the short summers. The average annual growing season ranges from less than 125 to 250 growing degree-days above 5°C. The average annual number of frost-free days is about 20.

The underlying permafrost is continuous and the depths of thaw are shallow. Weakly developed Cryosolic soils predominate. Since many of the soils are calcareous or the bedrock is very resistant to erosion, plant growth is difficult. Sections of this area promote the notion of a barren arctic desert.

Herb- and lichen-dominated communities constitute the main vegetation cover. The latter are closely associated with the rock-fields and hilly upland areas. Common herbs are purple saxifrage, avens and arctic poppy, often mixed with shrubs such as arctic willow. On less extensive and wetter sites or areas of noncalcareous soils, a richer flora exists.

Mammals of the Northern Arctic Ecozone include Peary (a threatened species) and barren-ground caribou, muskox, wolf, arctic fox, polar bear, arctic hare, and brown and collared lemmings. Representative birds include red-throated loon, brant, oldsquaw, gyrfalcon, willow and rock ptarmigan, red phalarope, pomarine, parasitic, long-tailed jagers, snowy owl,

snow goose and snow bunting. In the marine environment, typical species include walrus (in the eastern half), bearded, harp and harbour seals (southeastern and east-central portions only), beluga whale and narwhal.

The Arctic Islands contain a variety of oceanic bodies. In the northern half, the waters are ice fast, even through the summer periods. Towards the south, open waters are more common in the summer, but pack ice usually persists offshore. The inter-island channels are shallow to deep. Marine fauna are most abundant in the eastern and western margins, rather than in the central cores.

Native hunting and trapping remain important land use activities. Unlike those of the Southern Arctic Ecozone, they have a strong marine focus. Much of the area is targeted for hydrocarbon development and several mining enterprises are active.

15. Arctic Cordillera

This ecozone contains the only major mountainous environment other than the Rocky Mountain system. It occupies eastern Baffin and Devon islands and most of Ellesmere and Bylot islands. While the mountains which dominate British Columbia and the Yukon are familiar, the chain which extends over the eastern edge of the Northwest Territories is not. These arctic mountains are typically masked by ice. Valley glaciers extend over much of the area at the foot of the mountains, whereas the higher elevations have ice caps. The prolonged cold climate which affects these terrestrial areas favours the development of these ice barrens. The marine element of this unit is markedly different. The major currents and associated upwelling systems are key factors in producing an aquatic ecosystem which is perhaps the most biologically rich in the Arctic.

Elevations generally range from sea level to 2000 m. The highest parts are strikingly crowned by ice caps and multiple glaciers. Much of the coast is dominated by high relief and long, narrow fjords. The valley walls are rocky or covered with colluvial and morainal debris.

The climate is very cold and arid. Higher elevations escape some of the extremely low temperatures that occur in lowland areas due to the intense surface-based inversions. Mean daily January temperatures range from -25.5°C in the south to -35°C in the north and mean daily July temperatures are about 5°C. Precipitation amounts to 200 to 300 mm, generally with higher totals on exposed

eastern slopes and at lower latitudes. The average annual growing season ranges up to about 125 growing degree-days above 5°C. The average annual number of frost-free days is between 0 and 20.

Vegetation at upper elevations is largely absent due to the permanent ice and snow. The lower mountain slopes and coastal margins provide some vegetative cover, which consists of herbaceous communities in the north and shrub communities in the south. Lichens are associated with rockfields throughout.

The Arctic Cordillera Ecozone is largely devoid of terrestrial mammals, although polar bears are common in coastal areas. Representative birds in the warmer coastal margins include northern fulmar, ringed plover, hoary redpoll

and snow bunting. The marine environment is typified by walrus, bearded, harbour, ringed and harp seals, narwhal, and beluga and killer whales. The endangered bowhead whale is also associated with the marine areas of this unit.

Deep water bodies, such as Baffin Bay and Smith Sound and the eastern ends of Lancaster and Jones sounds, are included in this unit. Open water and thin ice are striking phenomena which prevail throughout the winter in the Smith Sound area. In the spring, they spread southwards and westwards along Devon and Baffin islands.

In common with those of the Northern Arctic Ecozone, most of the native hunting activities are connected with the marine environment. Little other human activity takes place here.

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APPENDICES

Appendix 1: Levels of Ecological Generalization Proposed by the Canada Committee on Ecological Land Classification

Definitions:

- ECOZONE - an area of the earth's surface representative of large and very generalized ecological units characterized by interactive and adjusting abiotic and biotic factors.
- ECOPROVINCE - a part of an ecozone characterized by major assemblages of structural or surface forms, faunal realms, and vegetation, hydrological, soil and climatic zones.
- ECOREGION - a part of an ecoprovince characterized by distinctive ecological responses to climate as expressed by the development of vegetation, soil, water, fauna, etc.
- ECODISTRICT - a part of an ecoregion characterized by distinctive assemblages of relief, geology, landforms, soils, vegetation, water, and fauna.
- ECOSECTION - a part of an ecodestrict throughout which there is a recurring assemblage of terrain, soils, vegetation, water bodies, and fauna.
- ECOSITE - a part of an ecosection in which there is a relative uniformity of parent material, soil, hydrology, and vegetation.
- ECOLEMENT - a part of an ecosite displaying uniform soil, topography, vegetation, and hydrology.

LEVEL OF GENERALIZATION Common map scale*	EXAMPLES OF COMMON BENCHMARKS FOR RECOGNITION					
	Geomorphology	Soils	Vegetation	Climate	Water	Fauna
ECOREGION 1:3 000 000 to 1:1 000 000	Large-order landforms or assemblages of regional landforms	Great groups or associations thereof	Plant regions or assemblages thereof	Meso or small order macro	Large water basins	Assemblages of faunal communities
ECODISTRICT 1:500 000 to 1:125 000	Regional landforms or assemblages thereof	Subgroups or associations thereof	Plant districts or assemblages thereof	Meso or large order micro	Drainage pattern; water quality	Faunal community or some specialized habitat
ECOSECTION 1:250 000 to 1:50 000	Assemblages of local landforms or a local landform	Families or associations thereof	Plant associations or assemblages thereof	Large order micro to small order micro	River reaches, lakes and shoreland	Specialized habitat within a community or a lower order community
ECOSITE** 1:50 000 to 1:10 000	A local landform or portion thereof	Soil series or associations thereof	Plant association or community	Small order micro	Subdivision of above	Portions of a community or total habitats of some small species
ECOLEMENT 1:10 000 to 1:2 500	A local landform or portion thereof	Phases of soil series or a soil series	Parts of a plant association or subassociation	Small order micro	Sections of small streams	

* Map scales should not be taken too restrictively, as they will vary with the setting and objectives of the survey.

** More so than others, this level is frequently subdivided into phases to indicate a passing or temporary state (e.g. seral).

Appendix 2: General Ecozone Attributes

NO.	ECOZONE	CHARACTERISTICS
1	Tundra	Elongated, rugged chains of mountains; extensive areas of permafrost; arctic and alpine tundra vegetation, some boreal forest.
2	Cordillera	Mountain ranges with intermontane troughs; sporadic locales of permafrost; boreal forest vegetation.
3	Boreal	Coastal mountains and fjords; glaciers and icecaps prominent at higher elevations; rain forest vegetation; maritime climate.
4	Cordillera	Mountains interspersed with troughs and plains; vegetation and soil types complex; fruitlands, ranching, forestry significant activities.
5	Boreal	Interior plains; boreal vegetation; forestry and hardier cereal grain area.
6	Plains	Interior plains; wetlands extensive; tundra and some boreal forest vegetation; extensive areas of permafrost, especially in the northern portion.
7	Prairie	Extensive plains; former natural grassland; cereal grains and ranching; large urban centres.
8	Taiga Shield	Broad plains; low productivity and open woodlands; intermittent areas of permafrost; important caribou wintering area.
9	Boreal	Extensive interior plains and hills; boreal forest vegetation cover; important forestry area.
10	Shield	Vast organically dominated coastal plain; largely tundra cover; ground mostly waterlogged and frozen.
11	Hudson	Broad plains; remnant mixed deciduous vegetation; central agricultural and urban area for eastern Canada.
12	Mixed Wood	Mostly hills with occasional coastal plains; mixed eastern deciduous forest; important eastern agricultural and fishing area.
13	Atlantic	Broad plains; low shrub and mixed herb-lichen tundra vegetation; continuous permafrost; important summer and calving area for barren-ground caribou.
14	Southern	Extensive plains and hills dispersed in an arctic archipelago; lichen-herb tundra vegetation; important arctic marine wildlife area.
15	Arctic	Glacier- and snow-capped ridge of mountains; fjord-indented coast.
	Arctic	
	Cordillera	

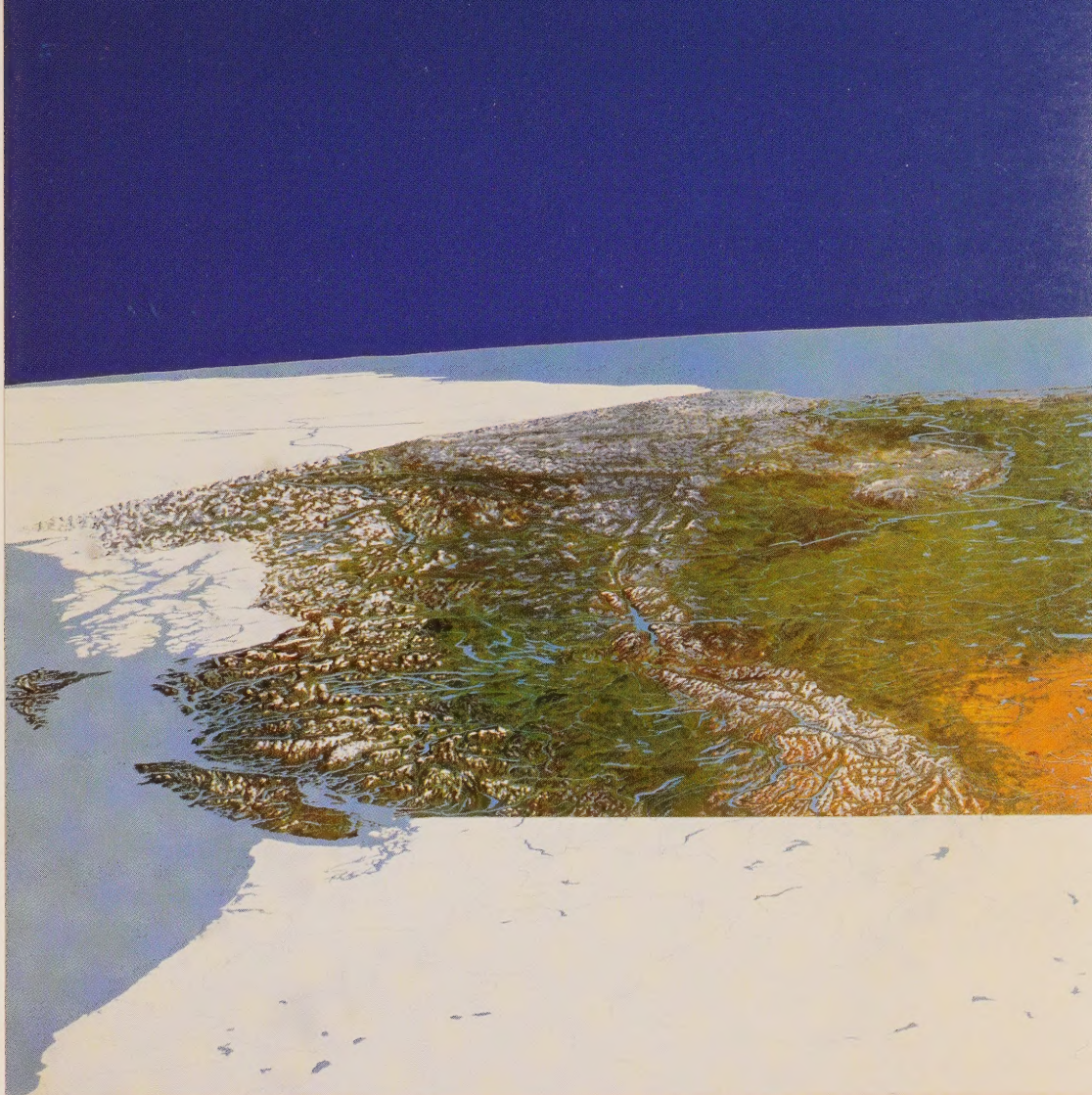
Appendix 3: Glossary

Tundra:	southern or altitudinal extent of treeless areas in northern North America and northern Eurasia, lying principally along the Arctic Circle, and on the northern side of the coniferous forests. For most of the year, the mean monthly temperature is below the freezing point; winters are long and severe, summers are short and warm, and the subsoil may be permanently frozen.
Cordillera:	a group of mountain ranges including valleys, basins, rivers and lakes. These mountain ranges generally have one dominant direction.
Montane:	pertaining to the western mountain forest, which is typified by Douglas fir, lodgepole pine, ponderosa pine and trembling aspen.
Boreal:	pertaining to the forest region which bridges much of the mid-latitudinal belt of Canada. White and black spruce are typical species.
Taiga:	a zone of forest-tundra transition vegetation encircling the Northern Hemisphere.
Plain:	an extensive, broad tract of level or rolling terrain.
Growing Degree-Days:	the growing degree-day concept utilizes a system of accumulated temperatures above a base or threshold temperature (5°C) to assess the suitability of temperature conditions for plant growth. Growing degree-day values are obtained by accumulating differences between 5°C and the mean daily temperature for every day of the year when the mean temperature is above 5°C. Each degree Celsius above 5°C is considered as one degree-day.
Frost-Free Period:	this is considered to be the number of days between the last spring frost and the first autumn frost. Frost is assumed to occur when the minimum daily temperature is 0°C or less.

Appendix 4: Area Estimates (Square Kilometres) for Ecozones and for the Jurisdictional Components of Each Ecozone (Excluding the Great Lakes and Marine Waters)

Jurisdiction	Ecozone	1. Tundra Cordillera	2. Boreal Cordillera	3. Pacific Maritime	4. Montane Cordillera	5. Boreal Plains	6. Taiga Plains	7. Prairie	8. Taiga Shield
Yukon Territory		231 769	216 303			24 193	5 413		
Northwest Territories		152 394				445	448 502		413 688
British Columbia			203 249		435 550	93 191	28 977		
Alberta				187 599	45 482	375 229	65 772	168 486	6 217
Saskatchewan						258 943		257 191	38 701
Manitoba						132 369		72 350	120 521
Ontario									
Quebec									496 751
New Brunswick									
Nova Scotia									
Prince Edward									
Island									
Newfoundland									
Total		384 163	419 552	187 599	481 032	884 370	548 664	498 027	236 298
									1 312 176

Jurisdiction	Ecozone	9. Boreal Shield	10. Hudson Plains	11. Mixed Wood Plains	12. Atlantic Maritime	13. Southern Arctic	14. Northern Arctic	15. Arctic Cordillera	Totals
Yukon Territory						4 836			482 514
Northwest Territories			5 198			734 824	1 371 328	253 304	3 379 683
British Columbia									948 566
Alberta		97 065							661 186
Saskatchewan		245 962							651 900
Manitoba		613 176	78 885						650 087
Ontario		721 127	277 969	89 176					980 321
Quebec		2 650	9 061	59 390					1 540 681
New Brunswick					18 673	156 193	79 486		73 436
Nova Scotia					70 786				55 491
Prince Edward					55 491				
Island									5 657
Newfoundland		123 529							404 517
Total		1 803 509	371 113	148 566	150 607	940 543	1 450 814	253 304	9 834 039



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